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EN 1279-1:2018

Glass in Building — Insulating glass units —
Part 1: Generalities, system description,
rules for substitution, tolerances and visual quality

прийнято як національний стандарт
методом підтвердження за позначенням

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З наданням чинності від 2022–08–15

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Glass in Building - Insulating glass units - Part 1: Generalities, system description, rules for substitution, tolerances and visual quality

Verre dans la construction - Vitrage isolant - Partie 1 : Généralités, description du système, règles de substitution, tolérances et qualité visuelle

Glas im Bauwesen - Mehrscheiben-Isolierglas - Teil 1: Allgemeines, Systembeschreibung, Austauschregeln, Toleranzen und visuelle Qualität

This European Standard was approved by CEN on 9 March 2018.

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Ref. No. EN 1279-1:2018: E

Contents

Page

European foreword

This document (EN 1279-1:2018) has been prepared by Technical Committee CEN/TC 129 "glass in building", the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2019 and conflicting national standards shall be withdrawn at the latest by January 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1279-1:2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

The main changes in comparison with the previous edition include:

a) Example of system descriptions was added;

b) Annex B: examples of IGU systems were transferred from part 6;

c) Annex C compatibility of components was added;

d) Annex D: rules to substitute materials and components were revised and combined in this part;

e) Annex F: visual appearance requirements were added.

EN 1279, *Glass in Building - Insulating glass units* consists of the following parts:

— *Part 1: Generalities, system description, rules for substitution, tolerances and visual quality;*

— *Part 2: Long term test method and requirements for moisture penetration;*

— *Part 3: Long term test method and requirements for gas leakage rate and for gas concentration tolerances;*

— *Part 4: Methods of test for the physical attributes of edge seal components and inserts;*

— *Part 5: Product standard;*

— *Part 6: Factory production control and periodic tests.*

This standard is written on the assumption of a 25 year period of use for IGUs.

No warranty can be derived thereof for the variety of different IGU designs, manufacturing procedures and particularly with regard to glazing situations. To ensure the full suitability and durability of new IGU designs or special product variants additional tests of components and/or IGUs may be required.

This means, that the described test procedures and all requirements of this standard, including factory production control, were worked out with the understanding that all values for characteristic's performances can be kept under relevant glazing situations in window and facades for this period without significant change.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document (all parts) covers the requirements for insulating glass units. The main intended uses of the insulating glass units are installations in windows, doors, curtain walling, bonded glazing for doors, windows and curtain walling, roofs and partitions.

The achievement of the requirements of this standard indicates that insulating glass units fulfil the needs for intended use and ensures by means of the evaluation of conformity to this standard that, visual, energetic, acoustic, safety parameters do not change significantly over time.

In cases where there is no protection against direct ultraviolet radiation or permanent shear load on the edge seal, as in bonded glazing for doors, windows and curtain walling systems, it is essential to follow additional European Technical Specifications (see EN 15434, EN 13022-1 and prEN 16759).

Insulating glass units that are intended for artistic purposes (e.g. lead glass or fused glass) are excluded from the scope of this standard.

Vacuum insulating glass is not covered by this standard (see ISO DIS 19916-1).

Glass/plastics composites are under the scope as long as the surface of contact with sealants is a glass component.

NOTE For glass products with electrical wiring or connections for, e.g. alarm or heating purposes, other directives, e.g. Low Voltage Directive, may apply.

This European Standard gives definitions for insulating glass units and covers the rules for the system description, the optical and visual quality and the dimensional tolerances thereof and describes the substitution rules based on an existing system description.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 572-1, *Glass in building — Basic soda lime silicate glass products — Part 1: Definitions and general physical and mechanical properties*

EN 572-2, *Glass in building — Basic soda lime silicate glass products — Part 2: Float glass*

EN 572-3, *Glass in building — Basic soda lime silicate glass products — Part 3: Polished wired glass*

EN 572-4, *Glass in building — Basic soda lime silicate glass products — Part 4: Drawn sheet glass*

EN 572-5, *Glass in building — Basic soda lime silicate glass products — Part 5: Patterned glass*

EN 572-6, *Glass in building — Basic soda lime silicate glass products — Part 6: Wired patterned glass*

EN 572-8, *Glass in building — Basic soda lime silicate glass products — Part 8: Supplied and final cut sizes*

EN 1279-2:2018, *Glass in building — Insulating glass units — Part 2: Long term test method and requirements for moisture penetration*

EN 1279-3:2018, *Glass in building — Insulating glass units — Part 3: Long term test method and requirements for gas leakage rate and for gas concentration tolerances*

EN 1279-4:2018, *Glass in building — Insulating glass units — Part 4: Methods of test for the physical attributes of edge seal components and inserts*

EN 1279-5:2018, *Glass in building — Insulating glass units -Part 5: Product standards*

EN 1279-6:2018, *Glass in building — Insulating glass units — Part 6: Factory production control and periodic tests*

EN ISO 12543-1, *Glass in building — Laminated glass and laminated safety glass — Part 1: Definitions and description of component parts (ISO 12543-1)*

EN 13022-1, *Glass in building — Structural sealant glazing — Part 1: Glass products for structural sealant glazing systems for supported and unsupported monolithic and multiple glazing*

ISO 11485-1, *Glass in building - Curved glass - Part 1: Terminology and definitions*

ISO 11485-2, *Glass in building - Curved glass - Part 2: Quality requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
insulating glass unit
IGU
assembly consisting of at least two panes of glass, separated by one or more spacers, hermetically sealed along the periphery, mechanically stable and durable (as specified in 6.1)

3.1.1
IGU type A
IGU, when used for installation without permanent shear load in the sealant and protected against direct UV exposure on edge seal

3.1.2
IGU type B
IGU, when used for installation with at least one edge not completely protected against direct UV radiation without permanent shear load in the sealant

3.1.3
IGU type C
IGU when used for installation as bonded glazing for doors, windows and curtain walling with possible permanent shear load on edge sealant with or without direct UV radiation exposure

Note 1 to entry: Permanent shear load can be avoided by mechanical support to carry the weight.

Note 2 to entry: For IGU type B and C additional requirements in accordance with EN 15434 and EN 13022-1 may apply.

3.2
bonded glazing for doors, windows and curtain walling
assembly in which glass products are fixed to the structural seal frame by means of a sealant that has been shown to be capable of withstanding the load actions applied to the glass products of the structural seal frame

NOTE Bonded glazing for doors, windows and curtain walling (see prEN 16759) was previously called structural sealant glazing (SSG) and is still used in some already published standards.

3.3
system
range of insulating glass units with a common edge seal design, edge seal materials and edge seal components as described in the system description, the range having a similar edge seal performance

NOTE Examples of edge seal performances are moisture penetration index, gas leakage rate.

3.4
system description
description of components and the edge seal of the insulating glass unit in terms relevant to identification, and in terms relevant to edge seal performance, e.g. moisture penetration index, gas loss rate

NOTE See Annex A.

3.5
permeation geometry
geometry of that part of the edge seal of the insulating glass unit through which the moisture and gas transmission takes place

NOTE For example see Figure 1.

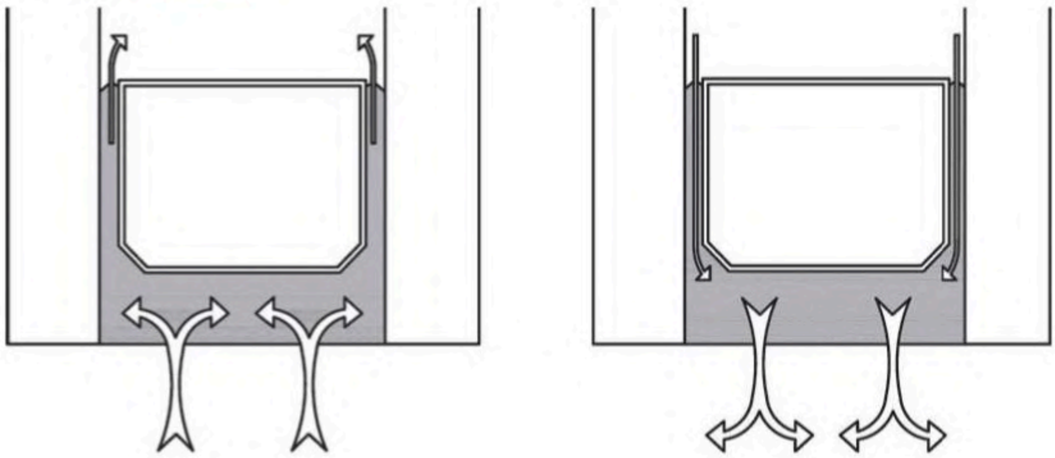


Figure 1 — Example of permeation geometry

3.6
cross-over stress
sealant tensile strength value at which its stress/strain curve crosses the line joining a stress of 0,50 MPa and a strain of 50 %

NOTE Value is determined following EN 1279-4:2018, Annex A.

3.7
cavity
gap between the panes of an insulating glass unit

3.8
dehydrated air or gas
air or other gas with a low water vapour partial pressure which, when introduced into the cavity, avoid the risk of condensation in the cavity

NOTE In all parts of EN 1279, the word "gas" refers to other gases or mixture of gases rather than air.

3.9
desiccant
component added to the system to absorb or adsorb immersing water vapour in the cavity over time

3.10
edge seal
assembled edge of an insulating glass unit, designed to ensure that moisture and gas transmissions between the inside and outside of the unit are limited, with a certain mechanical strength, and with a certain physical and chemical stability

3.11
sealant
polymer material that, after application, has sufficient mechanical and physical properties of cohesion and of adhesion to glass and/or spacer for use in edge seals

3.12
hot applied outer sealant
polymer material where an elevated temperature is required for application that, after application, has sufficient mechanical and physical properties of cohesion and of adhesion to glass and/or spacer for use in edge seals

3.13
double/dual seal system
edge seal system made of at least an inner sealant placed towards the cavity of the IGU and an outer sealant in contact with the environment outside the IGU

3.14
single seal system
edge seal system made of one single sealant

3.15
spacer
component used to separate the panes and control the width of the cavity at the edge of the insulating glass unit

NOTE The main families of spacers are given in Figure 2.

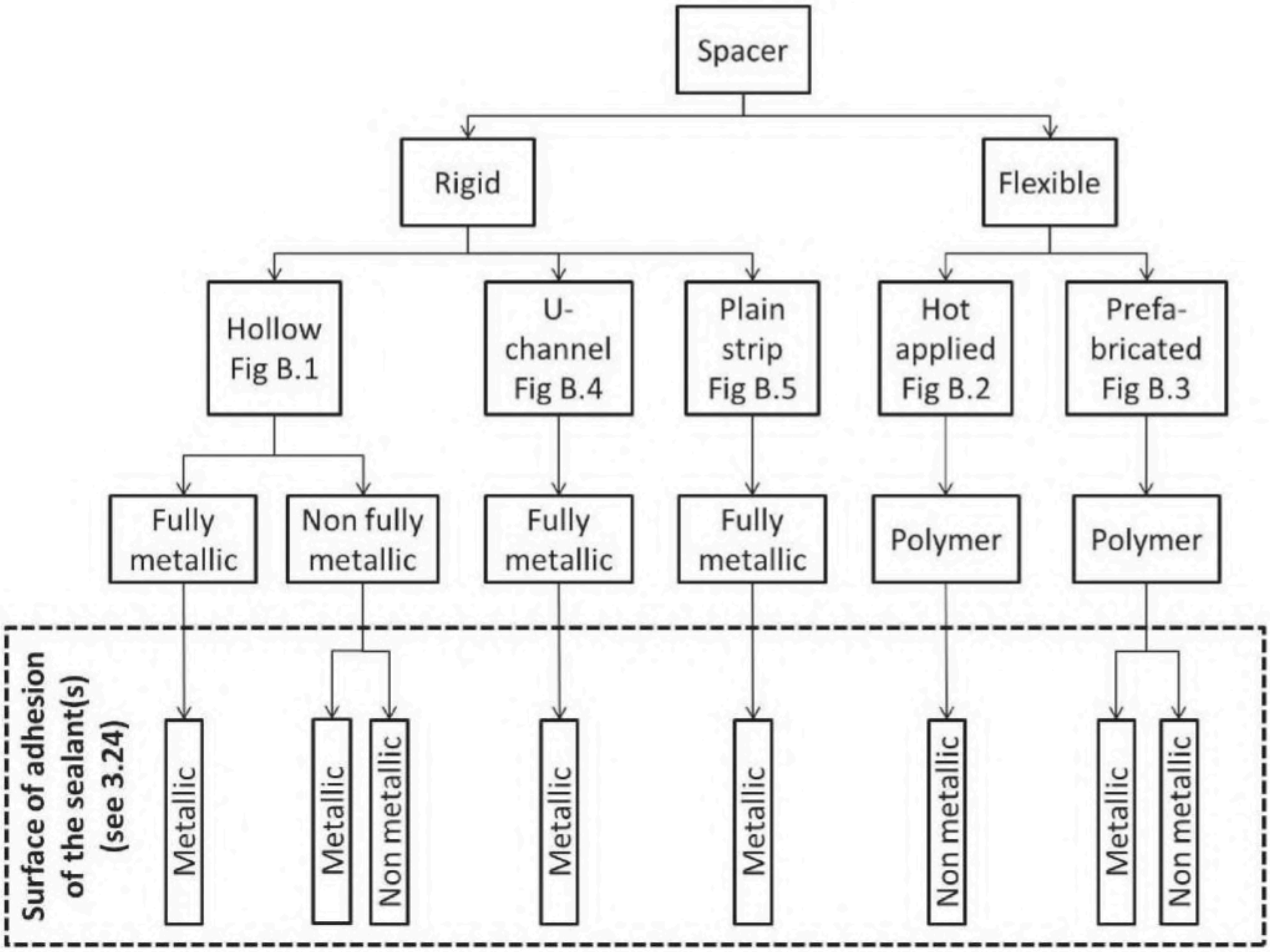


Figure 2 — Main families of spacers

3.16
hollow spacer
spacer intended to be filled with desiccant

3.17
rigid spacer frame
set of hollow spacers, that provide enough rigidity to be preassembled prior to application and applied against one pane of the insulating glass unit before the assembly

NOTE examples of rigid spacer frame are a frame bent with joint piece or connected with corner keys, or a welded frame.

3.18
hollow metallic spacer
hollow spacer, painted or not, where at least 1/4 of the inner sealant adhesion height r (see Figure 3) and all of the contact surface with outer sealant shall be metallic adhesion surface (see 3.23)

3.19
joint piece
piece that connects parts of a spacer

3.20
corner key
joint piece that acts as a corner of the spacer frame

3.21
hot applied flexible spacer
polymer-based spacer which is applied at elevated temperature

NOTE this spacer can be either prefabricated or extruded directly onto the glass surface.

3.22
prefabricated flexible spacer
polymer based flexible spacer which is supplied as a profile to the IGU manufacturerNote1 to entry: this spacer can either be hot applied or cold applied.

3.23
adhesion surface
contact surface between spacer and one or both sealant(s)

3.24
metallic adhesion surface
spacer adhesion surface made of rolled or extruded aluminium, galvanised steel, stainless steel, without organic surface treatment

NOTE Organic surface treatments are painting, organic coating, organic film, or organic overspray.

3.25
insert
constituent included in the cavity not directly in contact with the sealants of the edge seal

NOTE The permeation geometry can be modified as fixings or connections of the inserts may be in contact with the edge seals.

3.26
U-channel spacer
spacer made of a U-shaped metal strip generally filled with a desiccant matrix

3.27
desiccant matrix
materials based on a polymer containing desiccant placed in a U-channel spacer for the purpose to keep the cavity of the insulating glass unit dry

3.28
desiccant cartridge
container with desiccant, placed somewhere in the cavity

3.29
leaded light strip
lead strip usually self-adhesive used on surface 1 and/or 2 of the insulating glass unit to simulate leaded light, traditional or modern stained glass effects

3.30
edge deletion
process to remove the coating at the edge of a coated glass, which is intended to be the adhesion surface of the sealant(s)

3.31
external condensation
condensation appearing on the glass panes of an insulating glass unit either on the room side surface or on the external surface

3.32
internal condensation
condensation appearing on the glass panes within a cavity of an insulating glass unit

3.33
absolute limit
value of a parameter, given in the system description, which when exceeded requires remedial action in manufacturing, and removal of products from production for repair or destruction

NOTE For system description, see Annex A.

3.34
action limit
value of a parameter, given in the system description, which when exceeded requires remedial action in manufacturing

NOTE For system description, see Annex A.

3.35
spot fault
spherical or semi spherical disturbance of the visual transparency looking through the glass

NOTE It can be a solid inclusion, a gaseous inclusion, a pinhole in a coating or a spot defect in a laminated glass.

3.36
halo
area locally distorted, generally around a point defect when the defect is included in the glass pane

3.37
residue
residue is a material that remain on the glass surface, that can have the form of spot or patch

NOTE It is usually made of the seal material.

3.38
linear/extended faults
faults, which can be on or in the glass, in the form of deposits, marks or scratches that occupy an extended length or area

3.39
stain
defect larger than punctual defect, often irregularly shaped, partially of mottled structure

3.40
cluster
accumulation of very small defects giving the impression of stain

3.41
edge defect
defects which can occur on the edge of a cut size piece in the form of entrant and emergent faults and / or bevels

3.42
misalignment
displacement of the edges of the glass during the manufacture of insulating glass unit

3.43
water vapour transmission rate
WVTR ($g \cdot m^{-2} \cdot d^{-1}$)
quantity of water vapour steadily transmitted through a 2 mm sealant film at specified conditions of temperature and water vapour concentration

NOTE Water vapour transmission rate (WVTR) was called moisture vapour transmission rate (MVTR) in the previous version of the standard.

3.44
gas permeation rate
GPR ($g \cdot m^{-2} \cdot d^{-1}$)
quantity of gas, steadily transmitted through a 2 mm sealant film at specified conditions of temperature and gas concentration

3.45
standard laboratory conditions
ambient temperature of (23 ± 2) °C and relative humidity of (50 ± 5) %

3.46
gas
chemical compound or element in gaseous state

NOTE In the context of this standard gas is all gas other than air.

3.47
standard moisture adsorption capacity
Tc (%)
Total capacity of a desiccant material to adsorb moisture at specified conditions

NOTE Tc is expressed as the sum of AWAC and LOI following EN 1279-4:2018, Annex E.

3.48
moisture penetration index
I (%)
amount of available moisture adsorption capacity consumed

3.49
available water adsorption capacity
AWAC (%)
quantitative determination of the capacity of a desiccant to adsorb water under specified conditions

NOTE AWAC is expressed as the relative weight percentage increase due to water adsorption following EN 1279-4:2018, Annex E.

3.50
loss on ignition
LOI (%)
quantitative determination of the relative weight loss of a desiccant under specified conditions

NOTE LOI is expressed as the relative weight percentage decrease due to exposure in air at 540°C following EN 1279-4:2018, Annex E

3.51
gas-filled insulating glass units
insulating glass unit in which the cavity is filled with gas(es) usually for improving thermal insulation

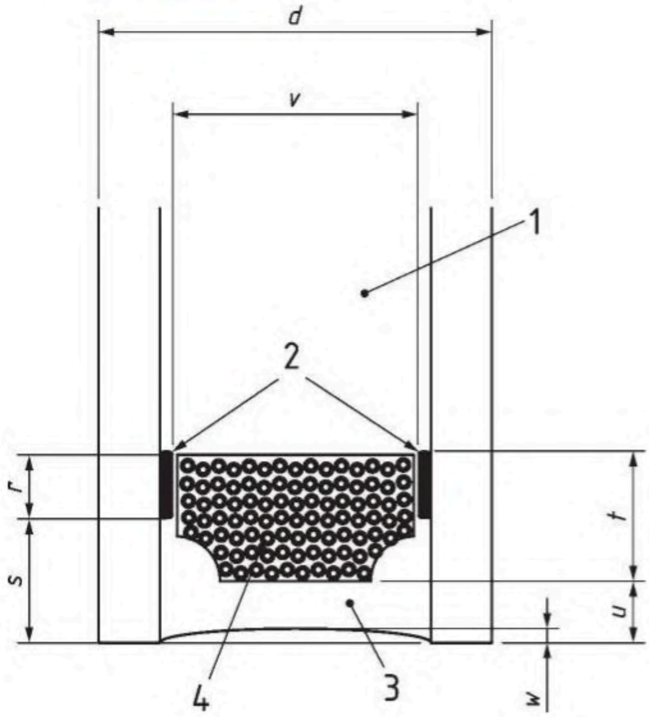
3.52
gas concentration
ci (%)
percentage by volume of gas in the cavity

NOTE gas concentration is determined by EN 1279-3 testing

3.53
gas leakage rate
Li ($\%.a^{-1}$)
gas volume leaking from insulating glass unit given in percentage of volume per year at 20 °C

4 Symbols and abbreviations for edge seal

The edge seal is characterized by its geometry and when relevant by the weight R of inner sealant per length (g/m). An example is given in Figure 3.



Key

1 cavity

2 inner sealant

3 outer sealant

4 spacer, containing desiccant

r average height of the inner sealant on glass surface

s average height of outer sealant on glass surface

t height of spacer

u average effective height of outer sealant on the back of the spacer

v width of spacer

w concavity of outer seal

d total thickness of IGU

Figure 3 — Example of edge seal dimensions

5 Requirements

5.1 General

The great number of possible different IGUs allow for a distinction to be made between systems, based on common edge seal design, edge seal materials and other edge components. For conformity control purposes, the manufacturer shall describe his system in a system description, which will be a part of the factory production control documentation. See also Annex A, Annex B and EN 1279-6:2018.

The rules for the system description are given in Annex A. It contains mainly a list of the applied edge seal materials and components, the nominal edge seal dimensions of the finished product, the action limits and the absolute limits.

Insulating glass unit systems can vary in the materials listed below, the limits in height, width, cavity width, glass thickness and number of cavities. These lists are not exhaustive.

It is the responsibility of the manufacturer to ensure that the compatibility of materials within an insulating glass system has been verified (see Annex C).

The possibility of substitution of different materials and other components are given in Annex D (see also Annex E).

5.2 Glass panes/components

5.2.1 General

Glass substrates used for the production of insulating glass units:

— shall be covered by Harmonized European Specifications (as defined in Regulation EU 305/2011) as listed below, or

— if not covered by Harmonized European Specifications, demonstration shall be made that those glasses have a chemical composition and a mechanical stability over time equivalent to the requirements of the relevant standard listed.

5.2.2 Basic glasses

These are glass products manufactured from soda lime silicate glass in accordance with EN 572-1 and consist of the following:

— Float glass	EN 572-2
— Polished wired glass	EN 572-3
— Drawn sheet glass	EN 572-4
— Patterned glass	EN 572-5
— Wired patterned glass	EN 572-6
— Supplied and final cut sizes	EN 572-8

5.2.3 Special basic glasses

These are glass products manufactured from a variety of compositions, which are in accordance with appropriate European Standards, and consist of the following:

— Borosilicate glass	EN 1748-1-1
— Glass ceramics	EN 1748-2-1
— Alkaline earth silicate glass	EN 14178-1
— Alumino silicate glass	EN 15681-1

5.2.4 Strengthened glasses

These are soda lime silicate glasses that have been strengthened by thermal or chemical means and are as follows:

— Heat strengthened EN 1863-1

— Chemically strengthened EN 12337-1

5.2.5 Thermally toughened safety glasses

These are glasses that have been toughened by thermal treatment and are as follows:

— Thermally toughened soda lime silicate safety glass EN 12150-1

— Thermally toughened borosilicate safety glass EN 13024-1

— Heat soaked thermally toughened soda lime silicate safety glass EN 14179-1

— Thermally toughened alkaline earth silicate safety glass EN 14321-1

— Heat soaked thermally toughened alkaline earth silicate safety glass EN 15682-1

5.2.6 Laminated glasses

These are glasses that are in accordance with EN ISO 12543-1 and consist of the following:

— Laminated glass EN ISO 12543-3

— Laminated safety glass EN ISO 12543-2

5.2.7 Coated glasses

— coated glass EN 1096-1

A list of coatings allowed to be used in direct contact with certain sealant(s) shall be established by and obtained from the coated glass manufacturer. Further layer combinations or coatings may be added to this list when evaluated in accordance with EN 1279-4:2018, Annex B.

If a combination coating / sealant is not in that list, the insulating glass unit manufacturer shall not use that sealant in direct contact with that coating,

Some coatings are not allowed to be used in direct contact with a sealant, whatever the sealant. In that case, the coating shall be deleted at the edges of the coated glass.

5.2.8 Surface worked glass

— Surface worked glass (e.g. sand blasted, acid etched).

The glass panes, processed or unprocessed, may be:

— transparent, translucent or opaque;

— clear or tinted.

5.2.9 Curved glass

— Curved glass ISO 11485, all relevant parts

5.3 Cavity fillings

The cavity between two panes may be filled with air and/or gas.

5.4 Cavity inserts

The cavity may contain inserts (e.g. plastic film or sheet, Georgian bars, blind, etc.) which shall meet the requirements of the fogging test. The volatile content shall be determined when relevant (see EN 1279-4:2018).

5.5 Shapes

The panes may have any shape.

6 Requirements

6.1 Durability of insulating glass units

Products intended to belong to the insulating glass unit system shall have their durability being ensured by the following:

— the requirements of EN 1279-5:2018, 4.2.2.15 being followed;

— the manufacturing process respecting EN 1279-6:2018.

These tests are deemed to evaluate the performance of the complete sealing barrier of a multi-paned insulating glass unit. Manufacturing insulating glass units with special sizes and/or construction which creates higher load in the system may require special consideration for design (e.g. for triple glazing):

— when asymmetrical or thick panes construction are used the tensile load on the sealant increases;

— when edge length is < 0,6 m the tensile load on the sealant increases significantly;

— when the cavity thickness is ≥ 18 mm the tensile load on the sealant increases significantly.

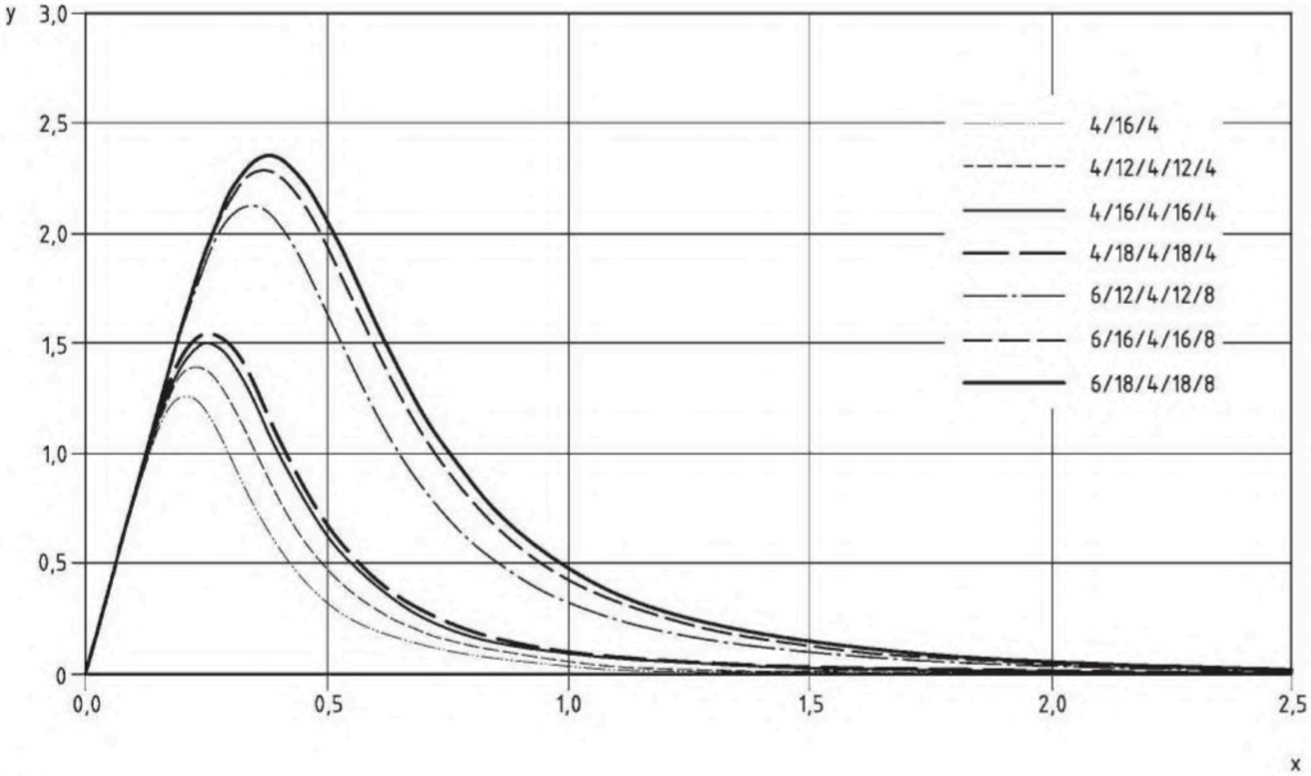
In these cases, a calculation of the edge seal tensile load should be made using prEN 16612:–[1)], Annex B. Calculation is made with climate load only. If the calculation result is higher than 1,3 N/mm the insulating glass unit edge seal design should be adjusted.

NOTE Some indicative examples of tensile load in the sealant are given in Table 1 and Figure 3. They refer to the boundary condition of EN 1279-2:2018 test (testing temperature: 58 °C, manufacturing temperature: 15 °C). These values are defined without altitude variation.

Table 1 — Comparative edge seal maximum tensile load in insulating glass units

Insulating glass unit design (dimension of 352x502 mm)	Edge seal Maximum tensile load (N/mm)
4/12/4	1,0
4/12/4/12/4	1,3
4/18/4/18/4	1,6
4/16/4	1,0

1) Under preparation. Stage at the time of publication: prEN 16612:2017.



Key

x length of the side (m)

y maximum tensile load (N/mm)

Figure 4 — Tensile load in insulating glass units depending on the design and the short side (ratio of sides is 1:3)

NOTE The maximum load values cannot be recalculated to maximum tensile load within the edge seal components.

Substitution of materials and of components shall maintain the conformity of the system with the definition of insulating glass units. The relevant rules are summarized in Tables D.1 to D.7, together with the validation methods. When meeting these requirements, the substituting materials and components shall be added to the system description.

Curved insulating glass units according to ISO 11485-1 comply with this standard without having to undergo additional tests provided that non curved insulating glass unit with the same system complies to EN 1279. In this case special attention shall be addressed to the design of the seal system.

6.2 Optical and visual quality of the insulating glass unit

Optical and visual quality requirements for insulating glass units are described in Annex F.

NOTE Other visual aspects are described in Annex G.

6.3 Dimensional tolerances

6.3.1 General

The following tolerances are based on the tolerances for single panes of glass given in the European Standards listed in 5.2, and offer the worst-case situations. Narrowing these tolerances can be a subject of contractual agreement between the insulating glass unit manufacturer and his glass supplier and/or his customer, or be in common usage in a local market. Where narrower tolerances are adopted, they shall be quoted in the insulating glass unit system description and/or in the manufacturer's quality manual, or in specific cases, cross-referenced to the particular contract details.

For curved glass ISO 11485-2 applies.

6.3.2 Height and width of the unit

When insulating glass unit dimensions are quoted for rectangular panes, the first dimension shall be the width, B, and the second dimension the height, H, as shown in Figure 4. It shall be made clear which dimension is the width, B, and which is the height, H, when related to its installed position.

NOTE For insulating glass units containing patterned glass panes, it is advised to specify the direction of the pattern relative to one of the dimensions.

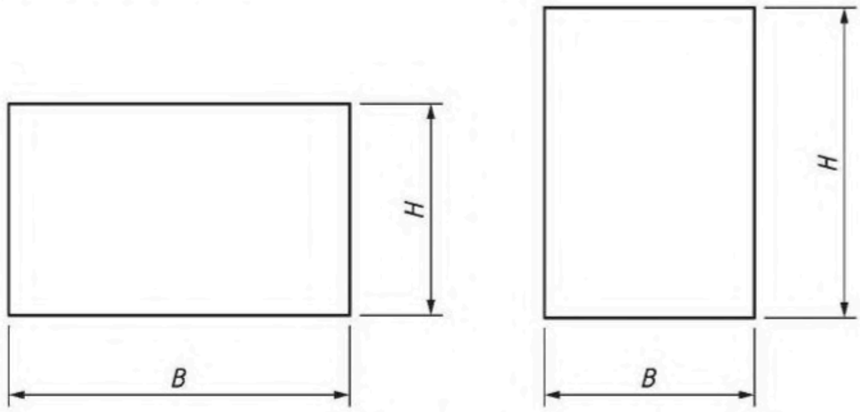


Figure 5 — Examples of width and heignt relative to the pane shape

The dimensional tolerances shall be part of the system description and subject to the factory production control in relevant clauses of EN 1279-6:2018. Guidance on dimensional tolerances are given in Table 2.

Table 2 — Guidance on dimensional tolerances of insulating glass units

Double / triple IGU	Tolerances on B and H	Misalignment
all panes ≤ 6 mm, and (B and H) ≤ 2 000 mm	± 2 mm	≤ 2 mm
6 mm < thickest pane ≤ 12 mm, or 2 000 mm < (B or H) ≤ 3 500 mm	±3 mm	≤ 3 mm
3 500 mm < (B or H) ≤ 5 000 mm and thickest pane ≤ 12 mm	±4 mm	≤ 4 mm
1 pane > 12 mm, or (B or H) > 5 000 mm	±5 mm	≤ 5 mm
Thicknesses are nominal thickness.		

Special dimensions and tolerances may be agreed.

6.3.3 Thickness tolerances along the periphery of the unit

The actual thickness shall be measured between the outside glass surfaces of the unit, at each corner and at the approximate centre points of the edges. The values shall be measured to 0,01 mm accuracy and given to the nearest 0,1 mm. The measured thicknesses shall not vary from the nominal thickness given by the manufacturer of the insulating glass units by more than the tolerances shown in Table 3.

Table 3 — Thickness tolerances on the insulating glass units

Glazing	Pane	IGU thickness tolerance [a]
double glazing	All panes are annealed float glass	±1,0 mm
	At least one pane is laminated, patterned or not annealed glass	±1,5 mm
triple glazing	All panes are annealed float glass	±1,4 mm
	At least one pane is laminated, patterned or not annealed glass	+2,8 mm/ −1,4 mm

[a] If one glass component has a nominal thickness greater than 12 mm in the case of annealed or toughened glass, or 20 mm in the case of laminated glass, the insulating glass unit manufacturer should be consulted.

Annex A
(normative)

System description of insulating glass units

The system description shall contain at least:

— the IGU description including edge seal design and tolerances;

— a list of components including absolute limits for tolerances.

Action limits may be included.

The component descriptions shall consist of:

a) a drawing of a cross section of the sealed edge of the insulating glass unit to scale, with each component numbered (an example of this is given in Figure 3, see also Annex B). When not all components appear in the drawing, additional drawings shall be made;

b) a list of the components according to the numbering of the detailed drawing(s), and in accordance with the relevant examples of Annex B;

c) a list of inserts not detailed in the drawing;

d) a record for each of the components. Each record shall contain:

  — a reference to the drawing with number and functional name of the component;

  — the name of supplier(s) or manufacturer(s);

  — a general description of the material(s) used for the component (e.g. desiccant), followed where appropriate by some more detailed information (e.g. molecular sieve 3 Å);

  — a drawing with dimensions related to the permeation geometry, when relevant.

Annex B
(normative)

Examples of insulating glass unit systems

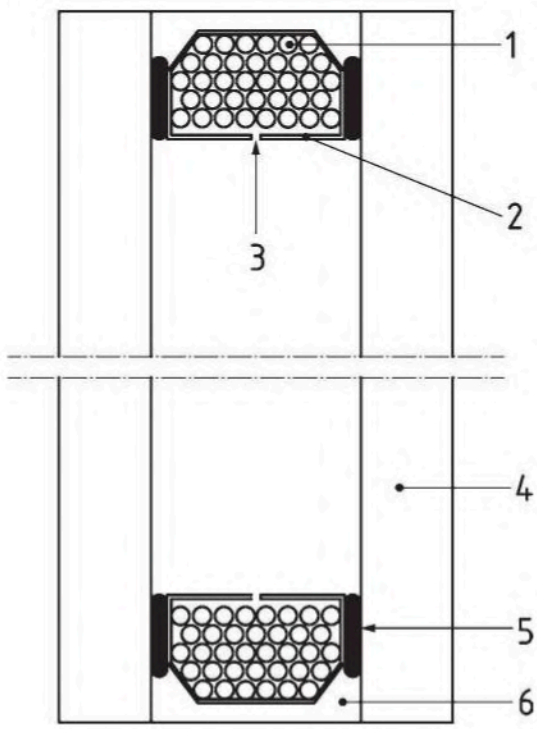
B.1 General

This annex gives examples of IGU systems commonly available. EN 1279-6:2018 gives the factory production control related to each of them.

Depending on the system, the insulating glass unit can be either air-filled or gas-filled.

B.2 Organic sealed insulating glass units with rigid hollow spacer

Figure B.1 shows the principle of organic sealed insulating glass units with rigid hollow spacer, with outer sealant (cold or hot applied).



Key

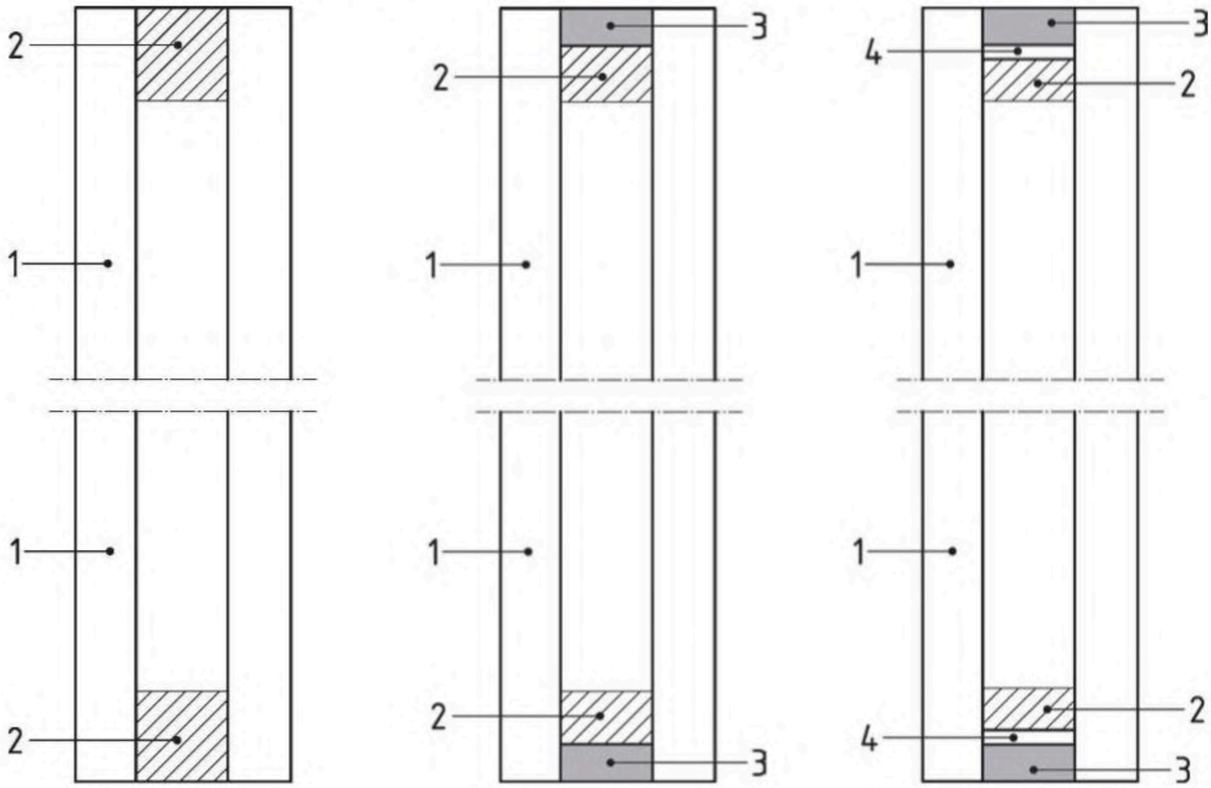
1	desiccant	4	glass
2	spacer bar	5	inner sealant
3	diffusion openings	6	outer sealant

Figure B.1 — Principle of an organic sealed insulating glass units with hollow spacer

B.3 Insulating glass units sealed by hot applied flexible spacer incorporating desiccant

Figure B.2 shows the principle of IGU with a flexible spacer frame with a hot applied flexible spacer incorporating desiccant.

This system may also comprise an outer sealant without desiccant and/or a permeation barrier or spacer, incorporated or not in the organic spacer during its production.



Key

1 glass

2 hot applied flexible spacer incorporating desiccant

3 outer sealant without desiccant

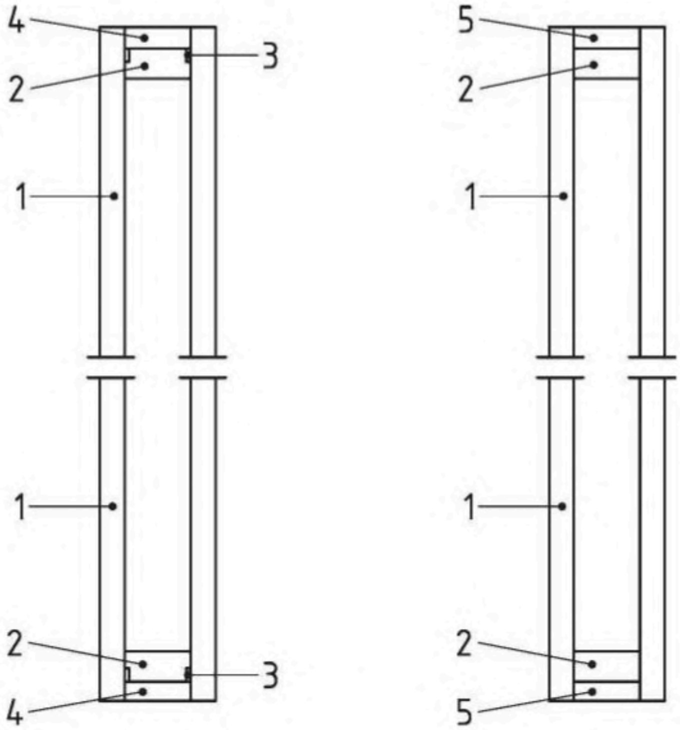
4 permeation barrier or spacer

Figure B.2 — Examples of insulating glass units sealed by hot applied flexible spacer incorporating desiccant

B.4 Insulating glass units with prefabricated flexible spacer

Figure B.3 shows the principle of insulating glass units with prefabricated flexible spacer.

Flexible spacers with pre-applied inner sealant are covered by this description.



Key

1 glass

2 flexible spacer with water permeable polymer

3 pressure sensitive adhesive

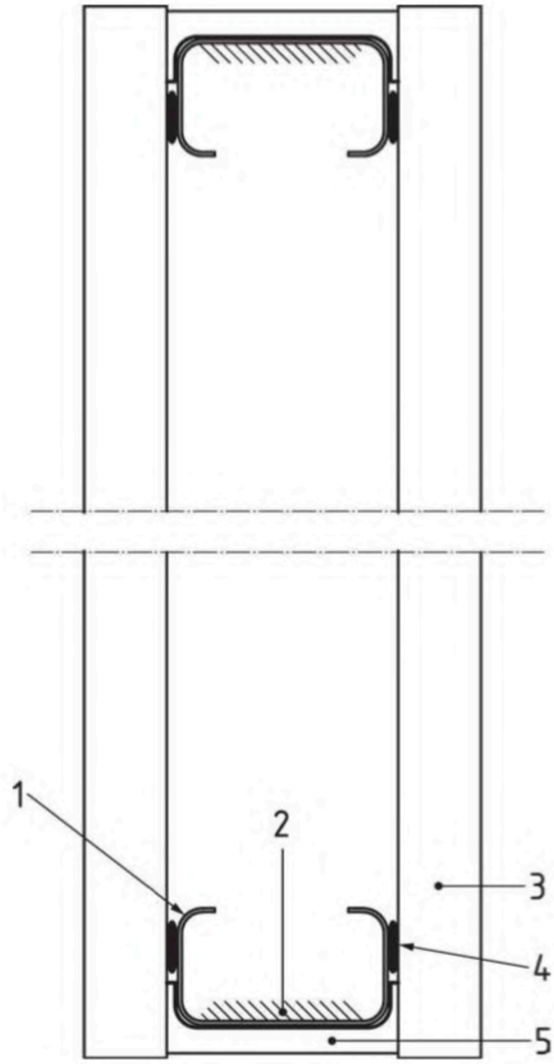
4 moisture/inert gas barrier

5 outer sealant

Figure B.3 — Principle of an insulating glass unit with prefabricated flexible spacer

B.5 Organic sealed insulating glass units with U-channel shaped spacer incorporating desiccant matrix

Figure B.4 shows the principle of organic sealed insulating glass units, where the spacer is a U shape metallic spacer incorporating an extruded organic desiccant matrix.



Key

1 spacer

2 desiccant matrix

3 glass

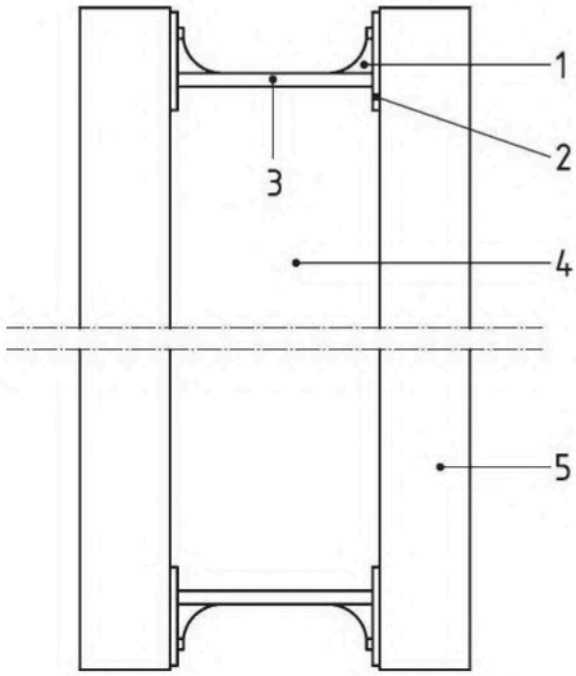
4 inner sealant

5 outer sealant

Figure B.4 — Principle of an organic sealed insulating glass unit with U shaped metallic spacer incorporating an extruded organic desiccant matrix

B.6 Air filled insulating glass units sealed by a metal strip between the glass panes

Figure B.5 shows the principle of metal sealed air-filled insulating glass units with metal strip as spacer.



Key

1 solder
2 copper and tin layer
3 metal strip
4 dehydrated air
5 Glass

Figure B.5 — Principle of an insulating glass unit sealed by a metal strip between the glass panes

Annex C
(informative)

Compatibility of components within an insulating glass unit system

C.1 Compatibility

The components are considered to be compatible if their interaction within the insulating glass unit does not affect the relevant properties of the unit over the expected life time.

C.2 Diffusion and equilibrium

Some products contained in the IGU components which are not chemically bound within the matrix, such as plasticisers, catalysts, antioxidants, light stabilizers, etc. may migrate. When components are brought into direct contact, migration may lead to diffusion of products between components.

The speed of this diffusion will depend on the partial pressure difference, the molecular weight of the material, the ambient temperature, the dimensions of the components, and the solubility of the migrating products in the matrices of the components involved.

The diffusion processes come to an end, when the equilibrium of all migrating products is reached.

C.3 Contact

Direct contact occurs if two components are in contact.

Indirect contact occurs if two components have direct contact to a third material which is able to absorb or adsorb at least one of the migrating products of one of the two components.

C.4 Interaction

Components, within a system which are brought into direct or indirect contact, exchange migrating products due to the diffusion processes. The gain and/or loss of products cause changes in the physical properties of one or both components, such as modulus, volume, density, viscosity, and yield value.

Whilst the changes are mainly affecting the physical properties, in some cases chemical reactions may also occur.

The changes described above are called interaction.

C.5 Factors affecting compatibility

As a guideline some general statements can be made. It should be noted that these statements do not replace detailed evaluation on a case to case basis.

The risk of incompatibility due to interactions increases

a) when the amount of possible migrating products in the components increases;

b) at higher temperatures;

c) with higher mass ratio of components in contact;

d) with larger relative contact surface area between the components;

e) with lower surface tension of the migrating products.

The impact on properties of the components within IGUs is most critical:

f) on hot applied components such as primary sealants (PIB) or hot melts;

g) where volume change (swelling or shrinkage) causes multi-axial tension such as in the case of laminated glass interlayers;

h) where wetting properties are changed by products such as silicone or unsaturated plant oils.

NOTE For test methods, it is advised to refer to testing guides, i.e. [1], [2], and EN 15434:2006+A1:2010, Clause 7.

Annex D
(normative)

Rules to substitute materials and components, possible changes within components and addition in the system description

D.1 General comments

System description, quality manual and Factory Production Control (FPC) shall be updated whenever a substitution or change is undertaken.

The following processes on glass have no influence: thermally toughening, heat-soak thermally toughening, heat-strengthening, chemically strengthening and lamination of glass, provided that the adhesion surface is glass.

The chemical nature of the glass component (i.e. soda lime glass, borosilicate glass, glass ceramic, alkaline earth silicate glass, alumino silicate glass) has no influence on the durability of the IGU and substitution is allowed without condition.

Substitution is allowed for more than one component according to the tables.

What is not mentioned in these substitution rules is not allowed and a new type test is required.

These changes are valid for all types of IGU (type A, B and C). In case of substitution, components shall conform to the corresponding requirements of EN 13022-1 if applicable.

All type test reports shall also include the relevant technical information (e.g. dimensions of the seal).

D.2 Tables of possibilities to substitute materials and components, and of possible changes within components

In the following tables, index 1 refers to the type test before substitution and index 2 refers to the type test of the product that will substitute the initial one.

The component manufacturer's type test reports may be used to validate the substitution.

The dimensions, u, s and r, are indicated in Figure 3.

R is the mass of inner sealant per length and spacer side (g/m) .

In Tables D.1 to D.6 undated standard references mean that existing test reports obtained under the previous version of the standard can be used.

When the tables refer to "another party", it means implicitly reference to EN 1279-5:2016, Annex D.

Table D.1 — Substitution of outer sealant: validation methods and requirements

With:	Gas filling	Derived requirement and validation method
Same rigid spacer frame	Air or gas	Type test report according to EN 1279-2 is available, e.g. from the supplier or another party, - for a spacer frame system which is allowed for substitution according to Table D.4, and - where the substitute outer sealant is used, and with - $u_2 \geq u_1$ and/or $s_2 \geq s_1$, and either - $I_2 \leq 0,1$ and $WVTR_2 \leq 1,2$ x $WVTR_1$: Allowed with no restriction with regard to EN 1279-2, or - $0,1 < I_2 < 0,2$ and $WVTR_2 \leq WVTR_1$: Allowed with no restriction with regard to EN 1279-2 Stress/strain curve: Allowable deviation for crossover stress σ_c is ± 20 % or ± 0,02 MPa, whichever is the highest, from the cross over stress σ c of the original sealant. See also Annex E. All relevant parts of EN 1279-6:2018 shall be carried out.
	Gas	Type test report according to EN 1279-3 is available, e.g. from the supplier or another party, - for a spacer frame system which is allowed for substitution according to Table D.4 and - where the substitute outer sealant is used, and with - $u_2 \geq u_1$ and/or $s_2 \geq s_1$, and - $GPR_2 \leq 1,2 \times GPR_1$
Same glass coatings (not edge deleted, coatings)	Air or gas	Type test report according to EN 1279-2 is available, e.g. from the supplier or another party, - for a spacer frame system which is allowed for substitution according to Table D.4, and - where the same coating is used, and - where the substituted outer sealant is used Substitution is allowed when complying with EN 1279-4:2018, Annex B.
	Gas	Type test report according to EN 1279-3 is available, e.g. from the supplier or another party, - for a spacer frame system which is allowed for substitution according to Table D.4, and - where the same coating is used, and - where the substituted outer sealant is used - $u_2 \geq u_1$ or $s_2 \geq s_1$ Substitution is allowed when complying with EN 1279-4:2018, Annex B.

Table D.2 — Substitution of inner sealant: validation methods and requirements

With:	Gas filling	Derived requirement and validation method
Same rigid spacer frame with metallic adhesion surface	Air or gas	Type test report according to EN 1279-2 is available, e.g. from the supplier or another party, - for a spacer frame system which is allowed for substitution according to Table D.4, and - where the substitute inner sealant is used, and with - $r_2 \geq r_1$ or $R_2 \geq R_1$, and - $WVTR_2 \leq 0{,}5$ g.m^{-2}.d^{-1}. according to EN 1279-4 All relevant parts of EN 1279-6:2018 shall be carried out.
	Gas	Type test report according to EN 1279-3 is available, e.g. from the supplier or another party, - for a frame system which is allowed for substitution according to Table D.4 and - where the substitute inner sealant is used, and with - $r_2 \geq r_1$ or $R_2 \geq R_1$, and - $GPR_2 \leq 0{,}060\ 0$ g_{Ar}.m^{-2}.day^{-1} according to EN 1279-4

Table D.3 — Substitution of single sealant: validation methods and requirement

With:	Gas filling	Derived requirement and validation method
Same rigid spacer frame	Air or gas	Test report according to EN 1279-4 and EN 1279-2 are available, e.g. from the supplier or another party, - for a spacer frame system which is allowed for substitution according to Table D.4, and - where the substitute single sealant is used, and with - $u_2 \geq u_1$ or $s_2 \geq s_1$ and - $WVTR_2 \leq 0{,}5$ g.m^{-2}.d^{-1}. according to EN 1279-4 All relevant parts of EN 1279-6:2018 shall be carried out.
	Gas	Type test report according to EN 1279-3 is available, e.g. from the supplier or another party, - for a spacer frame system which is allowed for substitution according to Table D.4, and - where the substitute single sealant is used, and with - $u_2 \geq u_1$ or $s_2 \geq s_1$, and - $GPR_2 \leq 0{,}0600$ g_{Ar}.m^{-2}.day^{-1} according to EN 1279-4

Table D.4 — Substitution of rigid spacer frame and accessories: validation methods and requirement

Substitution of:	Gas filling	Derived requirement and validation method
Rigid spacer frame with metallic adhesion surface[a] (bent spacer by bent spacer or corner keys by corner keys, welded spacer by welded spacer)	Air or gas	Type test report according to EN 1279-2 is available, e.g. from the supplier or another party, with - $u_2 \geq u_1$ and/or $s_2 \geq s_1$, and - the calculated moisture penetration index *I* referring to the available desiccant volume shall respect the requirements of EN 1279-2. Fulfil requirement of EN 1279-6:2018, D.3.2.
	Gas	Type test report according to EN 1279-3 is available e.g. from the supplier or another party, with - $u_2 \geq u_1$ and/or $s_2 \geq s_1$
Rigid spacer frame with metallic adhesion surface, with corner keys by same spacer, bent or welded	Air or gas	allowed with no restriction
	Gas	Short climatic test following EN 1279-6:2018, B.4.
Rigid spacer frame with metallic adhesion surface, with bent or welded spacers by same spacer with corner keys	Air or gas	Type test report according to EN 1279-2 is available, e.g. from the supplier or another party - for the respective system, with - moisture penetration index $I_{av} \leq 0{,}15$, and - $u_2 \geq u_1$ and/or $s_2 \geq s_1$, and - available desiccant volume with bent spacers does not exceed available desiccant volume with corner keys
	Gas	Type test report according to EN 1279-3 is available, e.g. from the supplier or another party, on comparable geometry.
Rigid spacer frame with metallic adhesion surface, Corner keys 1 by corner keys 2 or joint piece 1 by joint piece 2	Air or gas	Metal to metal: allowed with no restriction. All other substitutions: short climatic test following EN 1279-6:2018.
	Gas	Short climatic test and gas concentration according to according to EN 1279-6:2018, Annex B.
Rigid spacer frame with metallic adhesion surface, Gas filling holes closing material	Gas	Same gas filling holes closing material type and different supplier: allowed with no restriction. Different gas filling holes closing material: short climatic test following EN 1279-6:2018, B.4.

a Subject to definition 3.24

Table D.5 — Substitution of glass: validation methods and requirement

Substitution of:	Gas filling	Derived requirement and validation method
Edge deleted coated glass by another edge deleted coated glass	Air or gas	Substitution is allowed
Non edge deleted coating 1 by non-edge deleted coating 2	Air or gas	Substitution is allowed when complying with EN 1096-2:2012, Annex F and EN 1279-4:2018, Annex B.
Glass surface by acid-etched surface	Air and gas	Substitution is allowed only when an inner sealant is used.

Substitution of:	Gas filling	Derived requirement and validation method
Glass surface by enamelled (ceramic frit) surface (EN 12150-1)	Air or gas	Substitution is allowed.

Table D.6 — Substitution of desiccants: validation methods and requirement

Substitution of:	Gas filling	Derived requirement and Validation method
Desiccant 1 by desiccant 2	Air or gas	Test report according to EN 1279-4:2018 for substitute desiccant is available, with - AWAC of the substitute shall be minimum 16,0 %. Type test report EN 1279-2 is available e.g. from the supplier or another party, - for the same or (an)other system(s), and - where the substitute desiccant is used. Recalculated Moisture penetration index with available spacer volume complies with EN 1279-2:2018.

Table D.7 — Substitution of gas: validation methods and requirement

Substitution of:	Derived requirement and Validation method
Argon by krypton or by mixture of both	Substitution is allowed. For calculation of U value according to EN 1279-5:2018, Annex A, a value of 1 % shall be used for *Li*.

D.3 Addition of components

D.3.1 Addition of cavity inserts without change of the permeation barrier design

Inserts shall pass a fogging test in accordance with EN 1279-4:2016, Annex C and a volatile test in accordance with EN 1279-4:2016, Annex H. Moisture which is introduced by components has to be taken into account for the moisture penetration index.

NOTE Fogging test and volatile test performed according to a previous version of the standard remain valid.

D.3.2 Addition of cavity inserts with change of the permeation barrier design

Type test report from supplier or another party according to EN 1279-2 and EN 1279-3 shall be required.

Inserts shall pass a fogging test in accordance with EN 1279-4:2018, Annex C and a volatile test in accordance with EN 1279-4:2018, Annex H. Moisture which is introduced by components has to be taken into account for the moisture penetration index.

If the sealants used in these test reports are different from those to be used, substitution rules according to Table D.2, shall apply.

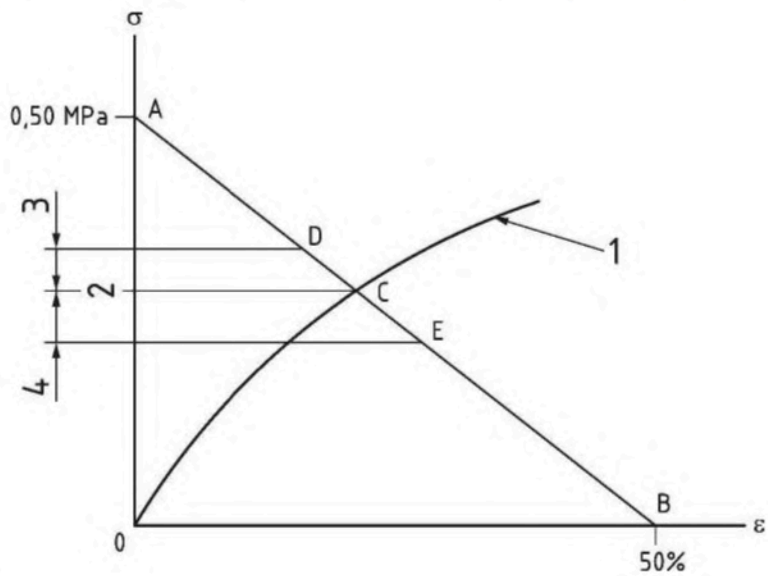
EN 1279-4:2018, Annex C and EN 1279-4:2018, Annex H shall be fulfilled in both cases.

NOTE Fogging test and volatile test performed according to a previous version of the standard remain valid.

Annex E
(informative)

Edge seal strength comparison in case of substituting outer sealant

The average stress-strain profile of the test specimens in the area AOB for each corresponding conditioning of testing (see EN 1279-4:2018, 5.2) shall be substantially the same as the profile obtained for the original tested as a type test. The cross over at line AB in Figure E.1 shall be within ± 20 % or ± 0,02 MPa, whichever is the highest, from the original cross over stress for each corresponding conditioning of test.



Key

1 stress strain curve of the original sealant. Failure shall be somewhere out of triangle OAB

2 cross over stress σ_c

3 allowable plus deviation

4 allowable minus deviation

Figure E.1 — Illustration of the allowable deviation

Annex F
(normative)

Visual quality of insulating glass units

F.1 General

This annex applies to assessment of the visible quality of insulating glass units made of glass components as defined in 5.2.

The optical and visual quality requirements for glass components shall be taken from the appropriate European Standards.

Tables F.1 to F.3 give the maximum allowable fault per insulating glass unit, as well as the faults that are specific to the assembly. These tables shall not be used for insulating glass unit with at least one component made of patterned glass, wired glass, wired patterned glass, drawn sheet glass, fire resistant laminated glass.

The tables cover insulating glass units of types A, B and C.

F.2 Observation conditions

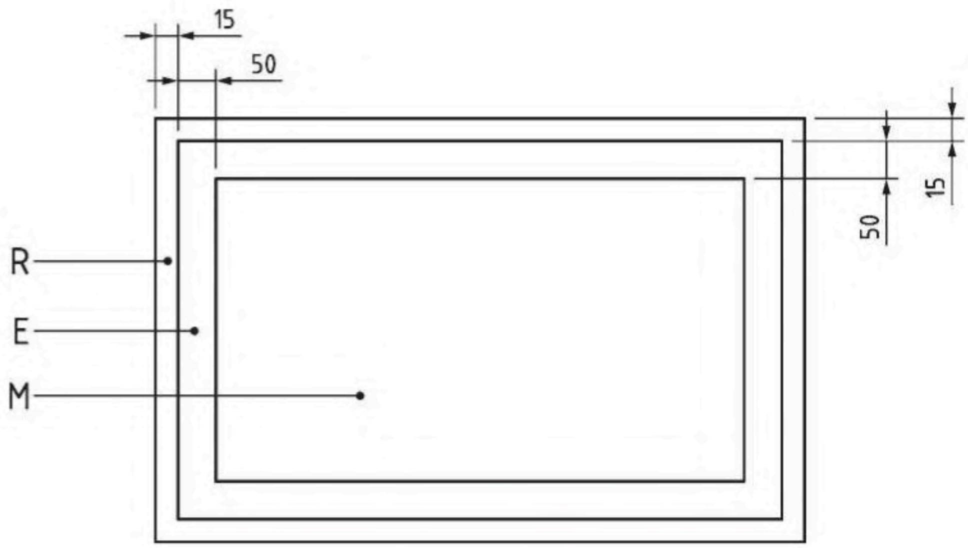
The panes shall be examined in transmission and not in reflection.

The discrepancies shall not be marked on the pane.

The insulating glass units shall be observed at a distance of not less than 3 m from the inside to the outside and at a viewing angle as perpendicular to the glass surface as possible for up to one minute per m^2. The assessment is carried out under diffuse daylight conditions (e.g. overcast sky), without direct sunlight or artificial lighting.

Insulating glass units assessed from the outside shall be examined in installed condition, taking into consideration the usual viewing distance with a minimum of 3 m. The viewing angle shall be as perpendicular to the glass surface as possible.

The following observation zones are defined in Figure F.1.



Key

R zone of 15 mm usually covered by the frame, or corresponding to the edge seal in case of unframed edge

E zone at the edge of the visible area, with a width of 50 mm

M main zone

Figure F.1 — Glass pane defect zones

F.3 Insulating glass unit made of two panes of monolithic glass

F.3.1 Spot faults

The maximum number of spots faults is defined in Table F.1.

Table F.1 — Allowable number of spot faults

Zone	Size of fault (excluding halo) (Ø in mm)	Size of the pane S (m^2)			
		S ≤ 1	1 < S ≤ 2	2 < S ≤ 3	3 < S
R	All sizes	No limitation			
E	Ø ≤ 1	Accepted if less than 3 in each area of Ø ≤ 20 cm			
	1 < Ø ≤ 3	4	1 per metre of perimeter		
	Ø > 3	Not allowed			
M	Ø ≤ 1	Accepted if less than 3 in each area of Ø ≤ 20 cm			
	1 < Ø ≤ 2	2	3	5	5 + 2/m^2
	Ø > 2	Not allowed			

F.3.2 Residues

The maximum allowable number of residue spots and stains is defined in Table F.2.

Table F.2 — Allowable number of residue spots and stains

Zone	Dimensions and type (Ø in mm)	Pane area S (m^2)	
		S ≤ 1	1 < S
R	All	No limitation	
E	Spots Ø ≤ 1	No limitation	
	Spots 1 mm < Ø ≤ 3	4	1 per m of perimeter
	Stain Ø ≤ 17	1	
	Spots Ø > 3 and stain Ø > 17	maximum 1	
M	Spots Ø ≤ 1	Maximum 3 in each area of Ø ≤ 20 cm	
	Spots 1 < Ø ≤ 3	Maximum 2 in each area of Ø ≤ 20 cm	
	Spot Ø > 3 and stain Ø > 17	Not accepted	

F.3.3 Linear / extended fault

The maximum number of linear / extended fault is defined in Table F.3.

Hairlines scratches are allowed provided that they do not form a cluster.

Table F.3 — Allowable number of linear / extended faults

Zone	Individual lengths (mm)	Total of individual lengths (mm)
R	No limitation	
E	≤ 30	≤ 90
M	≤ 15	≤ 45

F.4 Insulating glass units other than made of two monolithic glass panes

The allowable number of discrepancies defined in F.3. is increased by 25 % per additional glass component (in multiple glazing or in a laminated glass component) . The number of allowable defects is always rounded up.

EXAMPLES

— Triple glazed unit made of 3 monolithic glass panes: the number of allowable faults of F.3 is multiplied by 1,25.

— Double glazed unit made of two laminated glass with 2 glass components each: the number of allowable faults of F.3 is multiplied by 1,5.

F.5 Insulating glass unit containing a heat treated glass

The visual quality of thermally toughened safety glass, with or without heat soaking and of heat strengthened glass, when assembled in an insulating glass unit or in a laminated glass which is a component of an insulating glass unit, shall fulfil the requirements of their respective product standard.

In addition to these requirements, for heat treated float glass, the overall bow relative to the total glass edge length may not be greater than 3 mm per 1 000 mm glass edge length. Greater overall bow may occur for square or near square formats (up to 1:1.5) and for single panes with a nominal thickness < 6 mm.

F.6 Edge defects

Allowable edge defects are given in the relevant standard for each glass pane component.

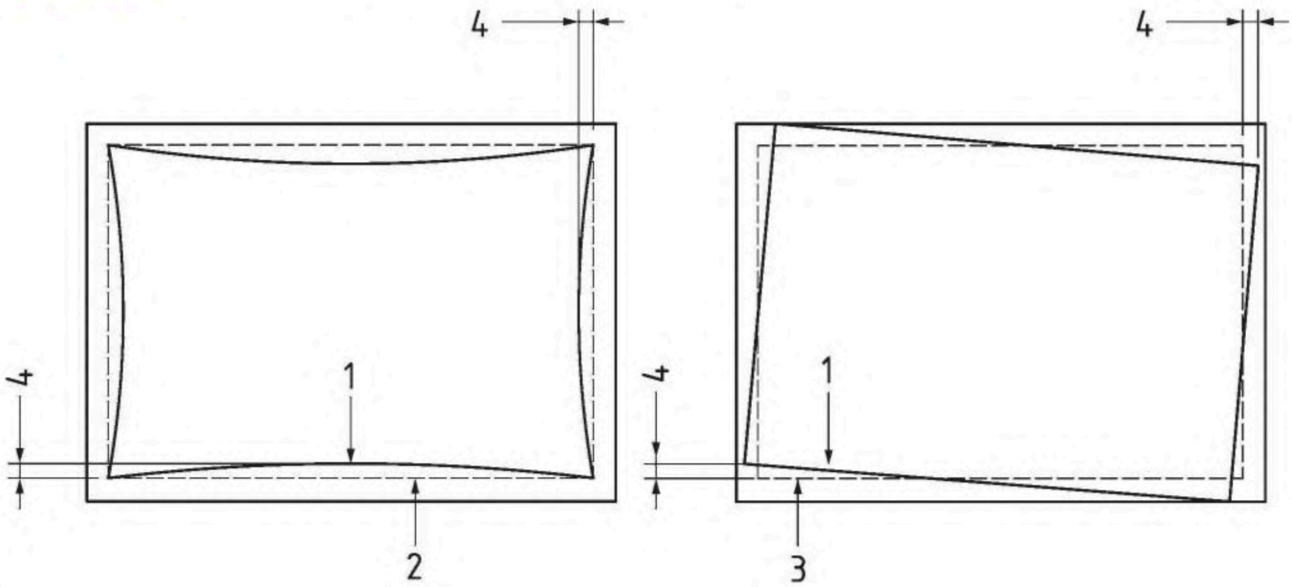
External shallow damage to the edge or conchoidal fractures which do not affect the glass strength and which do not project beyond the width of the edge seal are acceptable.

Internal conchoidal fractures without loose shards, which are filled by the sealant, are acceptable.

F.7 Tolerance on spacer straightness

For double glazing the tolerance on the spacer straightness is 4 mm up to a length of 3,5 m, and 6 mm for longer lengths. The permissible deviation of the spacer(s) in relation to the parallel straight glass edge or to other spacers (e.g. in triple glazing) is 3 mm up to an edge length of 2,5 m. For longer edge lengths, the permissible deviation is 6 mm.

Figure F.2 shows examples of deviation of spacer position.



Key

1 spacer

2 theoretical shape of the spacer

3 theoretical position of the spacer

4 deviation

Figure F.2 — Examples of spacer deviation

F.8 Curved insulating glass units

The visual quality of curved insulating glass units and their glass components shall fulfil the requirements of ISO 11485-1 and ISO 11485-2.

Annex G
(informative)

Other visual aspects of insulating glass units

G.1 General

Some physical effects can occur that are visible on the glass surface and shall not be taken into account when assessing the visual quality. They are not considered as defects.

G.2 Inherent colour

Variations in the colour impression are possible due to the iron oxide content of the glass, the coating process, the coating itself, variation in the glass thickness and the unit construction and cannot be avoided.

G.3 Difference in insulating glass unit colour

Façades made of IGUs incorporating coated glass can present different shades of the same colour, an effect that can be amplified when observed at an angle. Possible causes of differences in colour include slight variations in the colour of the substrate onto which the coating is applied and slight variations in thickness of the coating itself.

An objective assessment of the differences in colour can be done using ISO 11479-2.

G.4 Interference effect

In insulating glass units made of float glass, interference effects may cause spectral colours to appear. Optical interference is due to superposition of two or more light waves at a single point.

The effects are seen as variation in intensity of the coloured zones, which change when pressure is applied to the glass. This physical effect is reinforced by the parallelism of the surfaces of the glass. Interference effects occur at random and cannot be avoided.

G.5 Specific effect due to barometric conditions

An insulating glass unit includes a volume of air or other gas, hermetically sealed by the edge seal. The state of the gas is essentially determined by the altitude, the barometric pressure and the air temperature, at the time and place of manufacture. If the insulating glass unit is installed at another altitude, or when the temperature or barometric pressure changes (higher or lower pressure), the panes will deflect inwards or outwards, resulting in optical distortion.

G.6 Multiple reflections

Multiple reflections can occur in varying intensity at the surfaces of glass units. These reflections can be seen particularly well if the background viewed through the glazing is dark. This effect is a physical property of all insulating glass units.

G.7 Anisotropy (iridescence)

Insulating glass units that contain a heat-treated glass component may show visual phenomena known as anisotropy, see EN 12150-1, EN 1863-1.

G.8 Condensation on the external surface of the insulating glass unit

Condensation can occur on the external glass surfaces when the glass surface is colder than the adjacent air.

The extent of condensation on the external surfaces of a glass pane is determined by the U-value, the air humidity, air movement and the indoor and outdoor temperatures.

When the ambient relative humidity is high and when the surface temperature of the pane falls below the ambient temperature, condensation at the glass surface occurs.

G.9 Wetting of glass surfaces

The appearance of the glass surfaces can differ due to the effect of rollers, finger prints, labels, vacuum suction holders, sealant residues, silicone compounds, smoothing agents, lubricants, environmental influences etc. This can become evident when the glass surfaces are wet by condensation, rain or cleaning water.

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[2] Ift-Guideline DI-02 engl/1, The usability of sealants — Part 2 Test of materials in contact with the edge of laminated glass and laminated safety glass (May 2009)

[3] EN 12488, *Glass in building — Glazing recommendations — Assembly principles for vertical and sloping glazing*

[4] EN 13022-2, *Glass in building — Structural sealant glazing — Part 2: Assembly rules*

[5] ISO 11479-2, *Glass in building - Coated glass - Part 2: Colour of façade*

[6] ISO/CD 19916-1, *Glass in building — Vacuum insulating glass — Basic specification of products evaluation methods for thermal and sound insulating performances*

[7] EN 1096-1, *Glass in building — Coated glass — Part 1: Definitions and classification*

[8] EN 1096-2:2012, *Glass in building — Coated glass — Part 2: Requirements and test methods for class A, B and S coatings*

[9] EN 1863-1, *Glass in building — Heat strengthened soda lime silicate glass — Part 1: Definition and description*

[10] EN 12150-1, *Glass in building — Thermally toughened soda lime silicate safety glass — Part 1: Definition and description*

[11] EN 12337-1, *Glass in building — Chemically strengthened soda lime silicate glass — Part 1: Definition and description*

[12] EN ISO 12543-2, *Glass in building — Laminated glass and laminated safety glass — Part 2: Laminated safety glass (ISO 12543-2)*

[13] EN ISO 12543-3, *Glass in building — Laminated glass and laminated safety glass — Part 3: Laminated glass (ISO 12543-3)*

[14] EN 13024-1, *Glass in building — Thermally toughened borosilicate safety glass — Part 1: Definition and description*

[15] EN 14178-1, *Glass in building — Basic alkaline earth silicate glass products — Part 1: Float glass*

[16] EN 14179-1, *Glass in building — Heat soaked thermally toughened soda lime silicate safety glass — Part 1: Definition and description*

[17] EN 14321-1, *Glass in building — Thermally toughened alkaline earth silicate safety glass — Part 1: Definition and description*

[18] EN 15434:2006+A1:2010, *Glass in building — Product standard for structural and/or ultra-violet resistant sealant (for use with structural sealant glazing and/or insulating glass units with exposed seals)*

[19] EN 15681-1, *Glass in building — Basic alumino silicate glass products — Part 1: Definitions and general physical and mechanical properties*

[20] EN 15682-1, *Glass in building — Heat soaked thermally toughened alkaline earth silicate safety glass — Part 1: Definition and description*

[21] prEN 16612:–[2], *Glass in building — Determination of the load resistance of glass panes by calculation and testing*

[22] prEN 16759, *Bonded Glazing for doors, windows and curtain walling — Verification of mechanical performance of bonding on aluminium and steel surfaces*

[23] ISO 11485-3, *Glass in building - Curved glass - Part 3: Requirements for curved tempered and curved laminated safety glass*

[24] ISO/CD 19916-1, *Glass in building — Vacuum Insulating Glass -Part 1: Basic specification of products and evaluation methods for thermal and sound insulating performance*

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